

**STRATEGY
RESEARCH
PROJECT**

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**DIGITIZING THE BATTLEFIELD
- A COMPARISON OF US AND UK STRATEGIES**

BY

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ABSTRACT

AUTHOR: Shipley, Gordon M S, Colonel, British Army

TITLE: Digitizing the Battlefield

FORMAT: USAWC Strategy Research Project

DATE: 6 April 1998 PAGES: 35 CLASSIFICATION: Unclassified

The UK, through the British Army 2000 (BA2000) Force Development Process, is addressing the changing strategic circumstances and technological challenges of the 21st Century. This will lead to a doctrinally coherent, capability based, modular Army.

There is a need to enhance operational effectiveness by the efficient and timely acquisition, processing, distribution and presentation of information. To achieve this, the UK intends to exploit the opportunities offered by advances in digital technology. This has resulted in the development of new doctrine and a requirement to digitize the battlefield.

The US also believes the army of the future must link the power of information processing technologies with evolving doctrine and organizational development to ensure decisive success in any future conflict. The US Army is using a series of Advanced Warfighting Experiments (AWE) to determine the value of digitization in the development of Army XXI.

This project will contrast the US and UK digitization initiatives and analyze the output of Force XXI AWE for relevant lessons.

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It is never possible to be certain about something until you have done it.

— Miss Marples

INTRODUCTION

The purpose of digitization is to exploit the opportunities offered by advances in digital technology in order to deliver operational benefits throughout the battlefield. Recent doctrinal developments require battlefield digitization to enhance operational effectiveness through the efficient and timely acquisition, processing, distribution and presentation of information tailored to meet the needs of commanders, weapons systems and supporters. As a result, operations will benefit from an increase in tempo, lethality and survivability. Throughout the battlefield, digital technology will link the various weapon systems which gather, process, transmit or use information. These include sensors, weapons platforms, headquarters, communications and computer systems which support command and control and specialist battlefield functions such as logistics.

BACKGROUND

The US Army is engaged in the digitization of the current army through the Force XXI process¹. The longer-term force structure for the period 2015 to 2025 will be developed from the Army After Next (AAN) initiative². Prior to this date the US does not expect any peer competitor or alliance to emerge. This period of relative stability coincides with the

obsolescence of the six main battle winning weapon systems³ and, along with an absence of a peer competitor, has enabled the US Army to consider a revolutionary change in their military capability. As a result the US Army is willing to take a risk in directing its declining military budget towards achieving information dominance⁴ throughout the battlefield.

It was the impact of information technology in the commercial world in the early 1990s, particularly the increasingly shorter time between major upgrades in capability, that was the focus of the US Army's modernization initiative. The perception was that computing power would revolutionize the processing and passage of information and force both a change in budgetary procedures and require an overhaul of current acquisition practice. This resulted in the coming together of acquisition and technology initiatives under the Force XXI process to deliver a digitized army by 2010. Force XXI comprised a progressive series of Advanced Warfighting Experiments (AWE).

The Task Force XXI (TF XXI) AWE was based on the digitization of a brigade and concluded with a National Training Center (NTC) exercise in March 1997. The aim of this experiment was to determine whether digitization did in fact improve operational tempo, lethality and survivability. The last of the Force XXI experiments, Division XXI (Div XXI) AWE, took place in November 1997 and considered digitization at the division and corps level. If successful these AWE would confirm the US Army's design for its first digital division in 2000 and lay the foundations for fielding the first digital corps by 2004.

UK's digitization effort originated in the conceptual and doctrinal work conducted for the British Army 2000 (BA2000)⁵ Force Development process. UK believed that superiority in the gathering and exploitation of information would be critical both prior to and during operations. However, the ability to collect, assess and disseminate information must remain in balance with the capabilities necessary to exploit the product. The Chief of the General Staff (CGS) stated⁶ that the British Army must be able to operate alongside the US Army and that there can be no opting out of the digitization process. The critical factors that affect the British Army's ability to operate alongside the future US Army are: changes in US doctrine, command and control, communications procedures and equipment, all of which effect allied and coalition operations. BA2000 assumed that the British Army will normally operate within a coalition - by contrast, Force XXI was designed to ensure that the US Army had overmatch and self-sufficiency in every aspect of conflict⁷. US conceptual military thinking differs from that of UK in this significant area. The US regards warfighting as a national enterprise and whilst hoping that a coalition will form, it make no such assumption⁸. UK, on the other hand, assumes that warfighting will be conducted within a coalition.

As UK is unlikely to afford an experimental process similar to Force XXI, it is vital that the British Army is able to draw lessons from the AWE experience. Awareness of how the TF XXI and Div XXI performed will help the British Army to focus on key areas of benefit. There is also a requirement to determine the extent to which the British Army should conform to the US Army digitization process in order to achieve an acceptable level of integration in combined or coalition operations.

SCOPE

This project aims to contrast the US and UK digitization initiatives and analyze the output of Force XXI AWE for relevant lessons. It is concerned primarily with land Command, Control, Communications and Information Systems (CIS) technology rather than doctrinal, organizational and training issues, except where they impact on CIS. At the time of writing the US Army has yet to produce its formal findings from the Division XXI AWE. Vulnerabilities that result from Information Operations and Electronic Warfare have yet to be reported.

DIGITIZATION INITIATIVES

Digitization is the application of information technologies to acquire, exchange, and employ information throughout the entire battlefield. Digital technologies enable units to receive timely information and speed up the command and control decision-cycle. For digitization to provide a fully integrated command and control capability from the strategic level down to the individual soldier or weapon platform, the Army requires seamless interoperability, constructed from a common set of standards and protocols. Initial development of CIS capabilities has focused on implementing commercial technical standards and protocols, similar to those used by the commercial internet, operating on off-the-shelf hardware.

US DIGITIZATION

The US believes that digitization will enable the Army of the 21st Century to win the information war and provide its commanders, weapon systems, and supporters with the information each needs for success. Current US Army force development objectives seek to maximize capabilities which provide information dominance⁹. Unlike BA2000 which looks towards an army structure for 2010¹⁰ and beyond, Force XXI addresses what is possible today. The Army After Next (AAN) process acknowledges that the majority of equipment upon which Force XXI is founded will be replaced by 2015, hence AAN examines conflict beyond 2015, and out to 2025. Unlike the UK whose force development process will lead to a doctrinally coherent, capability based, modular army, neither Force XXI nor AAN represents a total army solution, which presents the US with the possibility of a two-tier army. The US is therefore facing interoperability issues not just with allies and coalition partners but amongst their own forces.

The US believes that digitizing the battlefield is the application of information technologies to acquire, exchange, and employ timely information throughout the battlefield in order to provide clear and accurate situational awareness for effective mission planning and execution. Digitization will allow commanders to communicate vital battlefield information instantly, rather than rely on voice radio and liaison officers. It provides the commander with a digital information network that supports the integration of fire with maneuver and assures superiority in the command and control decision-cycle. Based on common data collected

through networks of sensors, command posts, and weapon platforms, a picture of the battlefield at each echelon can be created to enhance:

- a. Battle command - the integration of battle command functionality within and among weapon systems, command posts, sensors, and support systems.
- b. Situation awareness - the provision to commanders at all echelons the ability to maintain a clear picture of their part of the battlefield with an enhanced level of situational awareness.
- c. Lethality/survivability - the merging of state-of-the-art information technology into battle command systems.
- d. Logistics - the ability to rapidly determine, communicate, and respond to all logistic support requirements.
- e. Joint interoperability - to seamlessly interface a multi-layered battle command system to all echelons of command, and to allied and coalition partners.

The US Army modernization strategy will employ a system of upgrades that capitalize on the insertion of new technology, rather than developing new system platforms. This strategy offers an opportunity, through new procurement procedures, to integrate dissimilar weapons and

command and control platforms with common technologies, pre-planned product improvements, and incremental upgrades to weapon systems.

For the US, digitization is rightly seen as a complex affair: the size and nature of forces involved, the rate and complexity of technological change, the competition for resources, and the time needed for doctrinal development. Strong leadership, robust management and acceptance of financial risk and wastage has characterized the US digitization process.

UK DIGITIZATION

The prime focus for the US Army digitization effort is to maintain its own forces as the most dominant global military force. If the British Army wishes to conduct coalition operations alongside US forces, then the UK will need to ensure its doctrine and equipment allows it to do so. Once the US Army is fully digitized, a non-digitized force will be unable to exchange information efficiently, reducing the operational tempo for all. Full interoperability implies the ability to move information directly from one nation's database to the other, which requires the exchanged data to convey the same meaning. Defining the meaning of data is a complex and lengthy process, and protection of that data adds a further complication.

UK's concept for digitization is immature. However, the future army requirement is for multi-dimensional coordination of the joint battle, using a joint 'recognized operational picture' to enhance tempo, simultaneity and the integration of fire with maneuver. This will call for a

vastly increased requirement for timely and relevant information, which will place considerable emphasis on digitization to provide information dominance¹¹. Competition in the information environment will pervade all levels of command, thereby placing a premium on information superiority¹².

The Executive Committee of the Army Board (ECAB) stated a requirement for “a single and fully interoperable Army C²IS¹³ for use in peace and war both on and off the battlefield by 2010¹⁴. To achieve this a Battlefield Information System (IS) Architecture was developed.

UK’s Battlefield IS Architecture (see Figure 1) follows the command structure and is based on the provision of two integrated Battle Management Systems (BMS): the Formation Battle Management System (FBMS) which extends from corps to battlegroup/major unit HQ, and the Battlegroup Battle Management System (BGBMS) that covers battlegroups or major units and below. There is also a Platform Integrated Command and Control System (PICCS) to provide a vehicle information systems infrastructure, and the Common Infrastructure for Battlefield Information Systems (CIBIS) provides infrastructure services including communications, Geographic Information Systems (GIS), databases and Application Program Interfaces (API). At each level of command the relevant BMS will allow commanders to command and control all combat, combat support (artillery, engineers and aviation) and combat service support (medical and logistics) resources under their command. Each BMS will provide support to headquarters and units during in-barracks and field training, operational preparation, deployment to theater, battle preparation, mission rehearsal, operations and recovery.

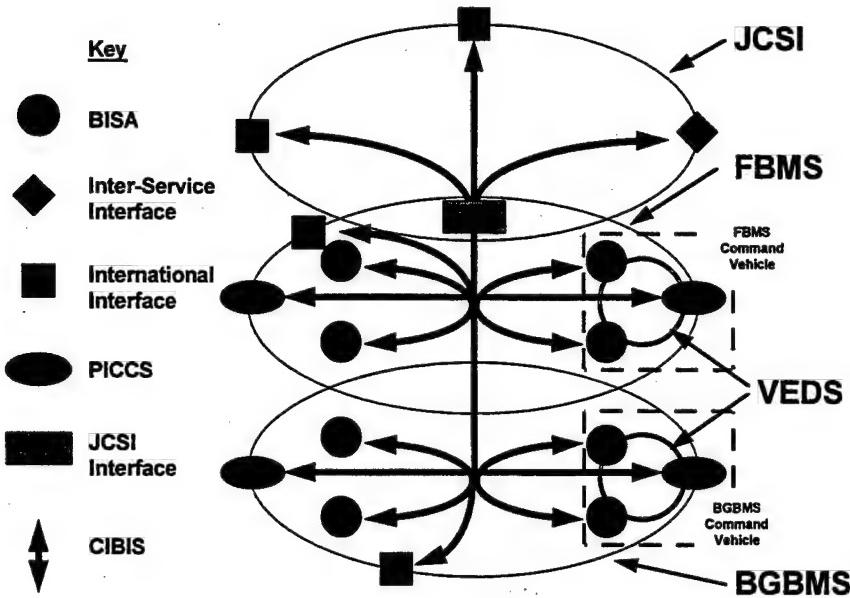


Figure 1: Battlefield IS Architecture

A key doctrinal requirement is the need for digitization to enable the conduct of joint and combined operations. The interface to joint systems and the command systems of our allies and coalition partners takes place predominantly at the level of the FBMS. The FBMS provides the interface to UK's joint Operations Command System (JOCS) and provides the Land Component Command (LCC) with the means to inter-operate with Maritime and Air components. NATO interoperability is also through FBMS to the Army Tactical Command and Control Information System (ATCCIS)¹⁵.

FBMS contains the high-level Information Technology (IT) functionality required by digitization (e.g. the software tools needed to implement situation awareness, picture

compilation, the management of high-volume intelligence data and other system functions). To establish an adequate linking of the major sources of data, FBMS requires several command vehicles to be coupled together through the high-capacity Vehicle External Distribution System (VEDS) Local Area Network (LAN). Only when these vehicles are coupled together and deployed as part of a headquarters is it possible to implement the main functions of FBMS.

BGBMS is not only the BMS for battlegroups and units, it is also the mechanism for maintaining command and control of all units under command and those transiting through an Area of Responsibility (AOR). At each level, the BMS will allow commanders to command and control the combat, combat support and combat service support resources assigned to them. This will include operational preparation, deployment to theater, battle preparation, mission rehearsal, operations and recovery.

Depending on the circumstances, a command vehicle may use facilities associated with both BMSs. What determines which system is engaged are the task specific Battlefield IS Applications (BISA). A BISA is defined in terms of the functionality it delivers to a group of users who participate in a particular military process. Although users at different command levels may contribute in various ways to a military process, a BISA is based on the totality of the process across the battlefield. BISAs are grouped into the following major activities: Command Functions and Command Support, including Intelligence; Combat Support; Combat Service Support; and mission specific (e.g. Indirect Fire, Logistics, Medical, and Transportation).

The digitized battlefield concept within the UK is still in its infancy and further developmental work will be required before a mature plan emerges. Unlike the US, the UK is still planning on equipping all Regular and Territorial Army units with some level of digital capability. This will require, over a planned six year period: the replacement of all combat radios, the proliferation of hand held and vehicle mounted computers, the rewiring with fiber optics and installation of computers in all combat vehicles (25,000), the development of BMS software, the development of doctrine and tactics, and the re-training of the whole Army. It is vitally important therefore that UK pays close attention to the output of Force XXI AWE.

FORCE XXI AWE

Force XXI Mission: The US Army will redesign its operating forces to field a total Army force that is capable of meeting our Nation's 21st Century challenges.

— General Gordon R Sullivan¹⁶

CONDUCT OF FORCE XXI AWE

The purpose of the AWE was to experiment with new concepts, ideas and equipment to test and evaluate the capabilities of each echelon of command, the premise being: if information-age battle command capabilities exist across all command and weapon systems, the US Army will enjoy increased lethality, survivability and control operational tempo. The AWE addressed

three separate but complementary objectives: the redesign of the Army's operational forces; the redesign of the Institutional Army - those elements that generate, train and sustain the operational forces; and the development and acquisition of information age technologies - the overall enablers of Force XXI. Force XXI provided the framework within which to assess operational capabilities and determine how the US Army will fight in the 21st Century. It served as a basis to develop the capability to conduct successful operations under joint command, employing modern, knowledge-based warfare. It also examined technology alternatives that would enhance the lethality, survivability and command capabilities of the US Army.

Specific CIS Force XXI objectives were to: obtain information on the effectiveness of Appliqué¹⁷ and the Tactical Internet (TI)¹⁸ to allow procurement decisions to be taken; confirm the concept of a digitized TF in order to support the design of the US Army division of the 21st Century; evaluate each of the issues and initiatives in order to develop further operational concepts and requirements; and establish the training, tactics and procedures required for digitized TF operations.

Force XXI demonstrated that the way in which operational requirements definitions for information based technologies were expressed, and the way in which computer software and hardware is introduced into service, demanded creative acquisition. This involved the progressive integration of doctrine, equipment procurement and software development, and required simultaneous test and deployment to ensure all command and weapons systems could communicate together effectively.

The equipment development process demonstrated during the experiment was an example of successful acquisition streamlining. Compression of this process was achieved through cooperation across many government and industry organizations. The Force XXI Central Technical Support Facility (CTSF) was an important innovation that fostered many of the interoperability achievements. The CTSF was composed of engineers, technicians, and soldiers who replicated the command and control equipment installed in the brigade and battalion tactical operations centers (TOCs). Interim software releases were vetted by CTSF operators to ensure that the "system of systems" operated correctly before deployment into the field. The ability to quickly troubleshoot many systems in one location greatly reduced the time to resolve issues and improved the effectiveness of a unit's training time. As well as controlling software configuration management the CTSF also enhanced new equipment, training and tactics, techniques, and procedures.

The premise for Div XXI was: 'If the Force XXI division operational and organizational concept enables information dominance and battle command capabilities, then increases in lethality, survivability and tempo will be gained across the Force.'¹⁹ Compared with TF XXI AWE, the Div XXI AWE was broader, with both national, joint and international interoperability issues being addressed. It involved the analytical community more closely and used the Battle Command Training Program (BCTP) to provide feedback. Human factors and infrastructure implications were also analyzed. The exercise was characterized by two main questions: how much information did the commander have?; and how well did he use it? The AWE confirmed

the following: maintaining a degree of interoperability with the US will be fundamental to the future utility of the British Army; information overload is a major problem - procedures will be essential to restrict "who gets what" to the minimum for the task; and sound doctrinal thought will ease many technical challenges.

Early in the Force XXI process US Army leadership believed that the result would be a Revolution in Military Affairs (RMA). The AWE served to highlight the difficulties of digitization and any RMA must now be associated with the AAN. However, Force XXI should provide a product improved digitized division by 2000 and a digitized light corps by 2004. The experience gained in fielding these formations will enable the US Army in the period 2010 to 2015 to re-divert funds from information systems to the replacement of its major weapons systems with fully digitized platforms in time for AAN.²⁰

RELEVANCE OF FORCE XXI AWE TO THE BRITISH ARMY

In a climate of reducing budgets, Force XXI succeeded in the competition for resources against other equipment modernization programs. Unlike the US Army which can still afford to embark on a long and complex process of developing doctrine and equipment on the basis of experimentation, the British Army can only afford to focus on areas of high return. Whilst the US and UK remain close doctrinally, Force XXI was all about the passage of information, the fusion of information and the integration of information systems.

LESSONS FROM TF XXI

Tactical Internet (TI)

TF XXI showed that digitization brings an insatiable demand for data, making TI the key to the digitized battlefield. It is important therefore that the TI has the capacity and robustness to satisfy the operational requirement and should not reflect a commercial Internet notion that all information should be available to any user, everywhere on the battlefield. TI proved incapable of providing the same reliability for messaging compared to voice, which may require separate dedicated services. TF XXI demonstrated the difficulty of a single communications system handling both voice and data.

Voice and Data Contention

There is a limit to what digitization can do in the near term. For example, when in contact, platoon and company commanders preferred to use voice rather than data communications; voice was faster and provided an intangible element that does not come with digitization.²¹ This continued requirement for voice communications requires the manufacturer to develop more effective multi-mode combat radios that do not compromise either its voice or data capability.

Situation Awareness

Whilst a properly designed and operated situation awareness application is an extremely potent force multiplier, particular development challenges lie with the production of a useful common enemy picture. The results from the AWE strongly support the potential of digitization to provide improved situation awareness; pictures from Appliqué did provide leaders with the ability to see how friendly forces were arrayed throughout the battlefield. Situation awareness messages were timely (usually one second or less) and accurate (normally within 10 meters), but low system reliability affected soldier confidence and digital traffic reduced the range of voice communications.²² However, improved situation awareness does not necessarily lead to a better understanding of the situation. Complete understanding of the situation comes from observing the battlefield, listening to the radio, and watching the icons on the screen. Unfortunately the present state of Force XXI technology tied commanders to their TOCs; highly mobile digitized command posts will overcome this in the future.

The US Army believed that improved situation awareness would reduce fratricide. TF XXI did not prove or disprove this. The Appliqué and Tactical Internet (TI) did provide adequate visibility and speed of service for battalion and brigade level tracking but surprisingly did not reduce the incidents of fratricide compared to a normal NTC rotation.²³ Whilst the exact cause has yet to be determined this increase may reflect the larger than usual number of vehicles deployed on the battlefield and the fact that only a small number of platforms were equipped with the Battlefield Combat Identification System (BCIS).

Information Overload

Leaders must be cognizant of the potential for information overload. The TF XXI staff appeared to take longer to consolidate, correlate, and integrate the many sources of information. As doctrine and tactics, techniques, and procedures mature through the experimentation process, addressing schemes and filters at various echelons should help restrict data flow and improve efficiency. TF XXI served to highlight how quickly commanders at all levels became overloaded with information to the extent it became an impediment to timely decision making, preventing forces from operating inside the enemy's decision-cycle.²⁴

Command and Decision Making

TF XXI indicated that accelerated decision-making is an acquired skill - only a minority of commanders could cope with the combined pressures of situation awareness and the need for speed. Staff officers proved insufficiently adept at digital rather than more traditional staff skills. The decision-cycle was much faster than officers were used to and a substantial revision of traditional operational staff training will be required. For the commander presented with too much information there is a requirement for it to be filtered by properly trained data managers.

Command and Control

The commander has always had mechanisms available to him for command, control, and synchronization of his forces. However, to shorten his decision-cycle and to help make more informed decisions, digitization automates many of these functions. Although the US Army had a number of digital systems already fielded, Appliqué became the TF XXI C²I system²⁵ for the dissemination and sharing of situational awareness data at brigade level and below. Its performance was mixed but demonstrated enormous potential.

Command and control at the lower echelons will now be carried forward through the use of Force XXI Battle Command, Brigade and Below (FBCB2) (Appliqué was the prototype for FBCB2), with the communications infrastructure based on the TI. The development of FBCB2 must be closely synchronized and integrated with existing communications systems and weapons platforms.

The conclusion of the TF XXI marked the transition from FBCB2 development as an experimental approach to a more deliberate, but still streamlined, acquisition approach that supports the first digital division fielding in 2000. To ensure that an effective and suitable system is fielded to the soldier, the material developer must now strive to correct the shortcomings identified in the prototype hardware and software. This development is highly dependent on the ability to synchronize many projects, affecting project managers as well as program executive offices. Challenges to the successful fielding of FBCB2 include

synchronization with the developing TI, development of a robust network management capability, and seamless interoperability with the US Army Tactical Command and Control System (ATCCS)²⁶.

Information Fusion

Force XXI yet again proved that situation awareness and the best available intelligence were no substitute for good, decisive leadership. Digitization produced a blurring between information and intelligence, and Force XXI failed to indicate the appropriate level for fusion and analysis.

Global Broadcast Service (GBS)

As bandwidth becomes severely constrained particularly at echelons below brigade, TF XXI made considerable use of GBS. It not only provided high quality, timely information to those parts of the force not easily covered by communications (e.g. rear areas) but it also delivered large quantities of information direct to command and control databases. Information was then distributed around headquarters to many users without bandwidth restrictions.

Acquisition

TF XXI demonstrated that the traditional linear development and procurement processes were inadequate for fielding information based systems. The CTSF proved that software development can only be successful when the user and contractor work together in an environment which replicates battlefield conditions. Successful integration between command and weapons systems is only possible when developed and tested in parallel. Development must be accelerated to maintain pace with the CIS industry using Commercial off-the-shelf (COTS) hardware. To achieve this the US Army insisted on: senior leader commitment; aggressive timescales (this also produced mistakes); commitment of large resources; industry's cooperation; and bold procurement decisions. TF XXI would not have happened without a CTSF with considerable industry support.

Interoperability

The US Army's modernization program is a lengthy process which poses interoperability issues amongst their own forces, let alone allies and coalition partners. However, once a digitized light corps is equipped in 2004 it is likely these technologically advanced formations will deploy first. Therefore, if UK wishes to remain a serious coalition partner, issues of vertical and horizontal interoperability need to be addressed now. Unlike those US Army units not being modernized, UK has a unique opportunity to consider interoperability as part of its own digitization initiative. Assuming the US Army wishes to have coalition partners operating along-

side, the DOD must permit the transfer of relevant technology and direct industry to develop suitable digital interfaces and gateways. Some of this work is already in hand through the NATO Quadrilateral Interoperability Program (QIP)²⁷.

LESSONS FROM DIV XXI

Compared to TF XXI, Div XXI made considerable technical advances. However, the main constraint seemed to be the continued use of legacy systems which resulted in integration problems within ATCCS. Div XXI was constrained by the continued need for ATCCS to integrate a number of highly optimized legacy systems. Unlike UK with its proposed Battlefield IS Architecture, US Army integration of its older legacy systems is becoming increasingly difficult and maintenance of obsolete hardware is costly. UK's decision to dispense with legacy systems will pay dividends.

ATCCS has yet to establish upward integration with the Global Command and Control System (GCCS), denying access to the full joint environment. This continues despite the presence of US Defense Interoperability Environment (DIE) standards, which demonstrates that technical standards alone cannot guarantee interoperability.

Due to the integration problems within ATCCS, messaging is currently the primary means of information transfer and updating. As few command or weapons systems share databases with the same construction, database to database replication remains some way off.

With US variable message format (VMF) protocols in a state of flux it is very difficult for UK is to plan for message level interoperability. Limitations in the experimental design and analysis process meant that a number of applications did not receive thorough assessment; foremost was the value of efficient, reliable command and control messaging.

CONCLUSIONS

Through Force XXI, the US Army is moving into the information age. A series of AWE were conducted to provide senior leadership with evidence to validate their conviction that digitization would improve lethality, tempo and survivability. Acquisition and technology initiatives would then deliver a digitized force by 2010. If in the future UK wishes to operate alongside US forces, the British Army must embark on its own program of digitization. However, UK cannot afford to conduct AWE on the scale of Force XXI.

The aim of digitization was to provide seamless interoperability throughout the battlefield. The enhancements offered by digitization will enable the US Army to modernize through the incremental insertion of technology. However, allies and other parts of the US Army not being digitized will threaten operational tempo unless suitable digital interfaces are developed. To interface efficiently UK must develop its equipment and doctrine to match that of the US. UK's concept for digitization proposes a battlefield IS architecture that matches the command structure and interfaces to allied command systems. As the concept is immature it is important that UK pays close attention to the output of Force XXI.

Force XXI addressed the redesign of combat and support forces through the use of information age technologies. Appliqué and TI were fundamental to the experiment. The creation of the Central Technical Support Facility along with creative acquisition and the involvement of industry was fundamental to the success of Force XXI. Force XXI highlighted the difficulties of digitization and any RMA must now be associated with the AAN.

Force XXI was all about the passage of information, the fusion of information and the integration of information systems. Although a reliable TI is key to the digitized battlefield the communications system could not handle simultaneous voice and data, requiring industry to develop more effective multi-mode combat radios. Situation awareness proved to be an extremely potent force multiplier but low system reliability effected user confidence and appeared not reduce fratricide. Improvements in doctrine and techniques will be required to overcome information overload. Appliqué performance was mixed but demonstrated enormous potential. Its replacement, FBCB2, must be closely synchronized both with existing and future communications systems and weapons platforms. Force XXI blurred information and intelligence, failing to identify the appropriate level for fusion and analysis. TF XXI made considerable use of GBS to deliver large quantities of information to rear areas and direct to command and control databases. Successful integration between command and weapons systems is only possible when developed and tested in parallel.

With Div XXI the US Army made considerable technical advances compared to TF XXI.

The main constraint seemed to be the continued use of legacy systems which resulted from integration problems within ATCCS - UK's decision to dispense with legacy systems will pay dividends. Technical standards alone cannot guarantee interoperability and database to database replication remains some way off.

Despite experimental limitations, the AWE provided an unprecedented impetus to US Army digitization and force modernization process. Maintaining a degree of interoperability with the US will be fundamental to the future utility of the British Army, leaving UK little alternative but to follow suit.

Word Count: 5,732

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²⁶ ATCCS integrates MCS/P, ASAS FAADC2I, AFATDS and CSSCS.

²⁷ QIP is supported by US, UK, Germany and France.

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